



# Disk Interface Technology

## **Quick Reference Guide**

The demand for storage to be available anytime, anywhere is driving the development of a new mix of disk interface technologies. This guide provides a basic comparison of existing and emerging technologies to help sort through the options that are available today and in the future. A comparative matrix of key features follows.

### **Parallel ATA (ATA)**

Parallel ATA, commonly referred to as simply "ATA", is an industry specification that evolved from the original Advanced Technology disk-interface. The ATA standard, first developed in 1984 defines a command and register set for the interface between the disk drive and the PC. Today's ATA-133 interface delivers a maximum data transfer rate of 133 MB/sec and supports two parallel ports, with each port supporting two internal hard drives. ATA is currently the standard hard disk drive interconnect in desktop PCs and is implemented in many Direct Attached Storage (DAS) and Network Attached Storage (NAS) systems.

### **Parallel Small Computer System Interface (SCSI)**

Parallel SCSI, better known as "SCSI", is a shared bus technology that connects various internal and external devices to a PC or server. SCSI technology allows for connectivity of up to 15 devices, and Ultra320 SCSI supports a data transfer rate of up to 320 MB/sec. First approved as a standard in 1986, SCSI technology has evolved to be the most widely used interface in workstations, as well as in servers and networked storage systems today.

### **Fiber Channel (FC)**

Fiber Channel serves two purposes. It is both a high-speed switched fabric technology, and a disk-interface technology. It supports a maximum data transfer rate of 400 MB/sec (full duplex; or half duplex, dual loop configuration) over 30 meters of copper cable or 10 kilometers over single-mode fiber optic links. When implemented in a continuous arbitrated loop (FC-AL), Fiber Channel can support up to 127 individual storage devices and host systems without a switch. Disk arrays and backup devices directly attach to the loop rather than onto any one server. FC was first approved as a standard in 1994 and is primarily implemented in high-end SAN systems.

### **Serial ATA 1.0 (SATA)**

Developed in 2001, SATA is the first generation of the new disk interface technology replacing Parallel ATA. In desktops, SATA is expected to replace Parallel ATA as the primary internal storage for PCs. SATA 1.0 delivers a maximum data transfer rate of 1.5 Gb/sec (150 MB/sec) per port and its future roadmap shows growth to 6.0 Gb/sec (600 MB/sec). Advantages of SATA include a point-to-point interconnect that enables full bandwidth available to each device, lower pin-count, lower voltage, hot-plug capability, thin cabling, longer cable length and register-level compatibility with Parallel ATA. These added features make SATA an option for DAS, NAS and some Storage Area Network (SAN) systems where Parallel ATA may not have been considered.

### **Serial ATA II (SATA II)**

SATA II is the second-generation SATA disk interface technology currently under development by the SATA working group. The SATA II specification picks up where SATA 1.0 left off, and will be deployed in 2 phases. The first phase, called "Extensions to Serial ATA 1.0", focuses primarily on addressing the needs of servers and networked storage. These include queuing, enclosure services, hot plug, cold presence detect, cabling and backplane improvements. The second phase is anticipated to scale performance to 3.0 Gb/sec (300 MB/sec) per port. These combined enhancements will make SATA II a good option for DAS, NAS and SAN storage systems where price/performance and cost are key factors.

### **Serial Attached SCSI (SAS)**

Serial Attached SCSI (SAS) is under development by the T10 standards committee. This committee is addressing the future limitations of the parallel SCSI interface, principally the bandwidth scaling limitations inherent in a parallel interface. SAS will deliver a maximum data transfer of 3.0 Gb/sec (300 MB/sec) per device, and it can support up to 128 devices via an expander. One of the key features of SAS is its anticipated ability to allow users to connect either a SATA or a SAS hard disk drive in an enclosure with expander capabilities. Its point-to-point configuration and highly scalable architecture makes SAS a good option for mid-range to high-end DAS, NAS and SAN storage systems.

## Current and Emerging Disk Interface Technologies

	ATA	SCSI	Fiber Channel	SATA	SATA II <sup>1</sup>	Serial Attached SCSI <sup>1</sup>
<b>PERFORMANCE</b>						
Technology Introduction <sup>2</sup>	2000	2002	2001	2002	2003	2004
Maximum Bus Speed <sup>3</sup>	100MB/s shared/channel	320MB/s shared/channel	4.0Gb/s (400MB/s) dedicated or shared <sup>4</sup>	1.5Gb/s (150MB/s) dedicated per device	3.0Gb/s (300MB/s) dedicated per device	3.0Gb/s (300MB/s) dedicated per device
Topology	Shared bus master/slave	Shared bus	Arbitrated loop/switched fabric <sup>5</sup>	Point-to-point	Point-to-point	Point-to-point
Number of Devices Per Channel	2	15	127 per arbitrated loop	1 (expandable to 128)	1 (expandable to 128)	1 (expandable to 128)
Command Queuing	No	Yes	Yes	Yes	Yes	Yes

<b>PRIMARY APPLICATIONS</b>						
Device Placement	Internal	Internal/External	External	Internal	Internal/External	Internal/External
Hard Disk Drive (HDD) Classes	Desktop	Enterprise	Enterprise	Desktop with some enterprise features <sup>7</sup>	Desktop with some enterprise features <sup>6,7</sup>	Enterprise
Devices Other than HDDs	Many	Many	Few	Many	Many	Few

<b>CHARACTERISTICS</b>						
Typical Internal Cable Width	2"	1 3/4"	5/32"	5/16"	5/16"	5/16"
Number of Cable Pins	40 (+40 conductors)	68 or 80	4	22 (7 signal)	22 (7 signal)	22 (7 signal)
Maximum Cable Length	18 inches	12 meters	10,000 meters	1 meter	6 meters	10 meters

<b>ADVANCED FEATURES</b>						
CRC in Protocol	No (Control) Yes (Data)	Yes	Yes	Yes	Yes	Yes
HDD Hot Plug	No	Yes	Yes	Yes	Yes	Yes

This guide provides a summary of some key differences in hard disk drive technologies available now and in the near future. Intel is a leader in a number of storage industry committees, and is continually working to develop improvements in current storage specifications and future storage technologies. To learn more about the technologies listed here and Intel storage products, please visit <http://www.intel.com/go/storage>

### Notes:

<sup>1</sup> These technologies are still being defined. This document reflects data known to be accurate at the time of publication.

For the most current information on SATA, please visit <http://www.serialata.org> and for SAS, please visit <http://www.scsita.org>

<sup>2</sup> Approximate time that products at the bus speed listed first appear.

<sup>3</sup> At product introduction. Parallel technologies are generally referred to in terms of Megabytes per second (MB/s) and serial, in terms of Gigabits per second (Gb/s).

<sup>4</sup> Assumes full duplex 200MB/s at half duplex.

<sup>5</sup> Point-to-point is also possible, however this is not commonly deployed.

<sup>6</sup> Native command queuing.

<sup>7</sup> CRC and hot plug are features traditionally associated with enterprise protocols.

<sup>8</sup> Assumes copper line. N/A if optical line is used.

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